

REMARKS

The applicant appreciates the examiner's thorough examination of the subject application and requests reexamination and reconsideration of the subject application in view of the preceding amendments and the following remarks.

Concerning item 1 of the subject action, the examiner objects to the "informal and roughly sketched" drawings originally submitted with the subject application. In response to this objection, applicant submits herewith three sheets of formal drawings.

Further, the examiner requests correction of one application informality within the specification. In response to this request, applicant has amended the specification of the subject application.

Concerning item 3 of the subject action, the examiner rejects claims 1-7 and 13-28, under 35 USC §102(b), based on the teachings of Dumoulin et al. (U.S. Patent No. 5,318,025).

Applicant claims (in amend claim 1) a flexible instrument, comprising: (a) a flexible member having an intermediate portion and a distal tip; (b) at least one fiber-optic intermediate sensor disposed at a predetermined point along said intermediate portion of said member for providing an intermediate path signal indicative of the path of said intermediate portion of said flexible member; and (c) at least one distal sensor positioned proximate said distal tip of said flexible member for providing a distal tip position signal which is independent of the intermediate path signal and indicative of the position of said distal tip of said flexible member.

Applicant respectfully asserts that Dumoulin et al fail to disclose element (b) of the applicant's claimed invention, namely "at least one fiber-optic intermediate sensor disposed at a predetermined point along said intermediate portion of said member for providing an intermediate path signal indicative of the path of said intermediate portion of said flexible member". Further, independent claims 14, 15, and 25 also refer to a "fiber-optic" sensor. Therefore, as Dumoulin et al fail to disclose each and every element of the applicant's claimed invention, applicant respectfully asserts that Dumoulin et al is not a proper basis for a 35 USC §102(b) rejection.

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Dumoulin et al concerns magnetic resonance imaging systems that use a plurality of magnetic sensors to track the position of a device, such as a catheter. As disclosed in the specification of Dumoulin et al (*See Generally Dumoulin et al, Column 3, Line 65 - Column 4, Line 50*), this reference concerns the use of a "device 150" that contains "at least two rf coils which detect MR signals". "These detected signals are sent to an imaging and tracking unit 170 where they are analyzed." "The position and orientation of device 150 is determined in imaging and tracking unit 170 and is displayed on a display means 180". Dumoulin et al fail to disclose the use of fiber-optic sensors or any of the equipment required to process signals received from fiber-optic sensors.

Accordingly, Dumoulin et al is not a proper basis for a 35 USC §102(b), rejection, as it does not disclose each and every element of the applicant's claimed invention. Therefore, applicant respectfully assert that independent claims 1 (as amended), 14 (as amended), 15 (as amended), and 25 (as amended) are patentable over Dumoulin et al. Further, as dependant claims 2-5, 13, 16-22, and 26-27 all depend (either directly or indirectly) on a patentable independent claim, applicant respectfully asserts that these claims are patentable also. Applicant has cancelled claims 6, 7, 8, 23, 24, and 28.

Concerning item 4 of the subject action, the examiner rejects claims 1, 8-12, 25 and 29, under 35 USC §102(e), based on the teachings of Danisch (U.S. Patent No. 6,127,672).

As stated above, applicant claims (in amend claim 1) a flexible instrument, comprising: (a) a flexible member having an intermediate portion and a distal tip; (b) at least one fiber-optic intermediate sensor disposed at a predetermined point along said intermediate portion of said member for providing an intermediate path signal indicative of the path of said intermediate portion of said flexible member; and (c) at least one distal sensor positioned proximate said distal tip of said flexible member for providing a distal tip position signal which is independent of the intermediate path signal and indicative of the position of said distal tip of said flexible member.

Applicant respectfully asserts that Danisch fails to disclose element (c) of the applicant's claimed invention, namely "at least one distal sensor positioned proximate said distal tip of said flexible member for providing a distal tip position signal which is independent of the intermediate path signal and indicative of the position of said distal tip of said flexible member". Further, independent claim 25 also refers to a "a distal tip position signal which is independent of

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the intermediate path signal" sensor. Therefore, as Danisch fails to disclose each and every element of the applicant's claimed invention, applicant respectfully asserts that Danisch is not a proper basis for a 35 USC §102(e) rejection.

Danisch concerns a flexible member that uses a plurality of bend and twist sensors. Danisch discloses that by knowing the spacing of these sensors and the degree of bend / twist of each sensor, the path and position of the flexible member can be determined. For a plurality of sensors positioned along a flexible member, Danisch relies on the calculated position of the previous sensor to determine the calculated position of the current sensor. The current sensor position is then used to calculate the position of the next sensor along the length of the flexible member. *See Generally Danisch, Column 8, Line 58 - Column 9, Line 45.* Therefore, the accuracy of any measurement for a particular sensor is directly dependant on the accuracy of the sensor preceding it in the sensor chain. Further, the accuracy of the sensor position measurement for the next sensor in the sensor chain is directly dependant on the accuracy of the position measurement for the current sensor. Therefore, any error present when determining the position of the first sensor propagates throughout the system.

Applicant's claimed invention uses a distal tip sensor that provides a distal tip position signal that is independent of, and therefore does not rely upon, the intermediate path signal. Therefore, any inaccuracy concerning the calculated position of the intermediate fiber-optic position sensor(s) does not impact the calculated position of the distal tip of the applicant's claimed invention.

Accordingly, Danisch is not a proper basis for a 35 USC §102(e), rejection, as it does not disclose each and every element of the applicant's claimed invention. Therefore, applicant respectfully asserts that independent claims 1 (as amended), and 25 (as amended) are patentable over Danisch. Further, as dependant claims 9, 10, 11, and 12 all depend (either directly or indirectly) on a patentable independent claim, applicant respectfully asserts that these claims are patentable also. Applicant has cancelled claims 8 and 29.

Attached is a marked-up version of the changes being made by the current amendment.

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Applicant : Donald Dieter Frantz, et al.
Serial No. : 09/703,031
Filed : October 31, 2000
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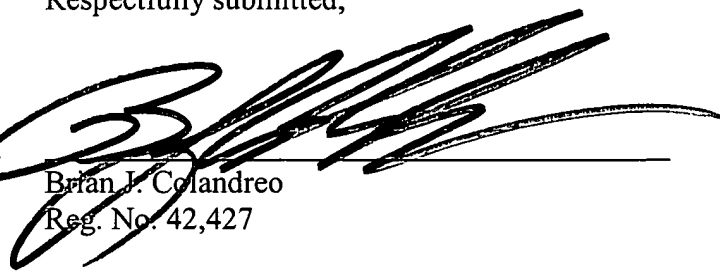
Attorney's Docket No.: 07508-027001

Applicant asks that all claims be allowed. Please apply any other charges or credits to
Deposit Account No. 06-1050.

Respectfully submitted,

Date:

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Version with markings to show changes made

In the specification:

Paragraph beginning at page 6, line 27 has been amended as follows:

One or more advantages can be provided from the above. As the three-dimensional position of the distal end of the flexible instrument is directly read, it is not subject to extrapolation errors. Accordingly, the propagation and extrapolation errors associated with calculating the three-dimensional position of the intermediate portion of the flexible instrument are minimized. By directly reading the three-dimensional position of the distal tip of the flexible instrument, the path of the intermediate portion of the flexible instrument can be more accurately plotted. Further, as the flexible instrument combines directly read and indirectly read position sensors, the three-dimensional position of the flexible instrument can be accurately plotted, even if the accuracy of one of the sensors is [comprised] compromised. The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

In the claims:

Claims 6, 7, 8, 23, 24, 28, and 29 have been cancelled.

Claims 1, 9, 10, 11, 14, 15, and 25 have been amended as follows:

1. A flexible instrument, comprising:
 - a flexible member having an intermediate portion and a distal tip;
 - at least one fiber-optic intermediate sensor disposed at a predetermined point along said intermediate portion of said member for providing an intermediate path signal indicative of the path of said intermediate portion of said flexible member; and
 - at least one distal sensor positioned proximate said distal tip of said flexible member for providing a distal tip position signal which is independent of

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the intermediate path signal and indicative of the position of said distal tip of said flexible member.

9. The flexible instrument of claim [8] 1 wherein said at least one fiber-optic intermediate sensor includes a fiber-optic flex sensor.
10. The flexible instrument of claim [8] 1 wherein said at least one fiber-optic intermediate sensor includes a fiber-optic twist sensor.
11. The flexible instrument of claim [8] 1 wherein said at least one fiber-optic intermediate sensor includes at least one optical fiber loop sensor having a light attenuation characteristic which varies in accordance with the path of said intermediate portion of said flexible instrument.
14. A flexible instrument, comprising:
 - a flexible member having an intermediate portion and a distal tip;
 - at least one fiber-optic intermediate sensor disposed at a predetermined point along said intermediate portion of said member for providing an intermediate path signal indicative of the path of said intermediate portion of said flexible member;
 - at least one distal sensor positioned proximate said distal tip of said flexible member for providing a distal tip position signal which is independent of the intermediate path signal and indicative of the position of said distal tip of said flexible member; and
 - a processor responsive to said intermediate path signal and said distal tip position signal for providing an indication, in a common reference frame, of the position and angular orientation of said distal tip and said intermediate portion of said flexible instrument.
15. A flexible instrument system, comprising:
 - a flexible member having an intermediate portion and a distal tip;

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at least one fiber-optic intermediate sensor disposed at a predetermined point along said intermediate portion of said member, said intermediate sensor providing an intermediate path signal indicative of the path of said intermediate portion of said flexible member; and

a pair of elements, one of said pair of elements being an energy transmitter and the other being an energy sensor, where one of said pair of elements is positioned proximate said distal tip of said flexible member and the other said element is positioned remotely, where the combination of said pair of elements provides a distal tip position signal which is independent of the intermediate path signal and indicative of the position of said distal tip of said flexible member.

25. A method for determining the three-dimensional position of a flexible instrument having an intermediate portion and a distal tip, comprising:

controlling a magnetic field proximate the flexible instrument;
generating, with at least one fiber-optic sensor, an intermediate path signal indicative of the path of the intermediate portion of the flexible instrument; and
generating a distal tip position signal which is independent of the intermediate path signal and indicative of the position of the distal tip of the flexible instrument.

In the abstract:

A flexible instrument includes a flexible member having an intermediate portion and a distal tip. At least one fiber-optic intermediate sensor disposed at a predetermined point along the intermediate portion of the member provides an intermediate path signal indicative of the path of the intermediate portion of the flexible member. At least one distal sensor positioned proximate the distal tip of the flexible member provides a distal tip position signal which is independent of the intermediate path signal and indicative of the position of the distal tip of the flexible member.

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